

APR 22 2010

Serial No.: 10/563,353
Docket No.: 28955.4040IN THE CLAIMS:

1. (Previously Presented) An organic electroluminescence device emitting white light which comprises a pair of electrodes, at least two light emitting layers and an electron transporting layer comprising a heterocyclic derivative having a nitrogen atom, the light emitting layers and the electron transporting layer being between the pair of electrodes, wherein

an energy gap of a host compound comprised in each light emitting layer $E_g(\text{Host-}i)$ satisfies following relation (I):

$$2.9 \text{ eV} \leq E_g(\text{Host-}i) \quad \dots (I)$$

wherein $E_g(\text{Host-}i)$ represents an energy gap of a host compound comprised in an i -th light emitting layer from the electron transporting layer, i representing an integer of 1 to n ,

an energy gap of the heterocyclic derivative having a nitrogen atom comprised in the electron transporting layer $E_g(\text{ETM})$ satisfies following relation (II):

$$2.9 \text{ eV} < E_g(\text{ETM}) \quad \dots (II)$$

and

an ionization potential of a host compound comprised in a light emitting layer adjacent to the electron transporting layer ($I_p(\text{Host-}1)$) and an ionization potential of the heterocyclic derivative having a nitrogen atom comprised in the electron transporting layer ($I_p(\text{ETM})$) satisfy following relation (III):

$$I_p(\text{ETM}) \leq I_p(\text{Host-}1) + 0.3 \text{ eV} \quad \dots (III);$$

wherein the host compound is capable of emitting blue light and is selected from the group consisting of anthracene derivatives, styryl derivatives, aromatic amines, aluminum chelates having mixed ligands and carbazole derivatives;

the energy gap is an excited singlet energy gap which is determined by obtaining an absorption spectrum of a 10^{-5} mole/liter toluene solution of a sample using an ultraviolet visible absorption meter and converting a wavelength at an absorption end on the absorption spectrum

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into energy value; and

the ionization potential is measured by obtaining a curve showing a change of discharged photoelectrons with a photon energy of irradiation using a photoelectron spectrometer, and determining by extrapolation a threshold value of the discharge of photoelectrons on the curve.

2. (Currently Amended) The organic electroluminescence device emitting white light according to Claim 1, wherein the energy gap of a host compound comprised in each light emitting layer $E_g(\text{Host-i})$ and the energy gap of the heterocyclic derivative having a nitrogen atom comprised in the electron transporting layer $E_g(\text{ETM})$ satisfy following relation (IV):

$$2.9 \text{ eV} \leq E_g(\text{ETM}) \leq E_g(\text{Host-i}) \quad \dots (IV)$$

$$2.9 \text{ eV} < E_g(\text{ETM}) \leq E_g(\text{Host-i}) \quad \dots (IV).$$

3. (Previously Presented) The organic electroluminescence device emitting white light according to Claim 1, wherein at least one light emitting layer comprises a dopant having an energy gap of 2.9 eV or smaller.

4. (Previously Presented) The organic electroluminescence device emitting white light according to Claim 1, which comprises at least two light emitting layers having different peak wavelengths of light emission.

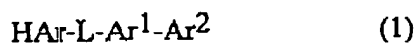
5. (Previously Presented) The organic electroluminescence device emitting white light according to Claim 1, wherein a difference between a greatest peak wavelength of light emission and a second greatest peak wavelength of light emission is 50 nm or greater.

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6. (Original) The organic electroluminescence device emitting white light according to Claim 1, wherein the electron transporting layer or an interfacial region between the electron transporting layer and a cathode comprises a metal having a work function of 2.8 eV or smaller or a compound of the metal.

7. (Original) The organic electroluminescence device emitting white light according to Claim 6, wherein the metal is Na, K, Rb, Cs, Ca, Sr or Ba.

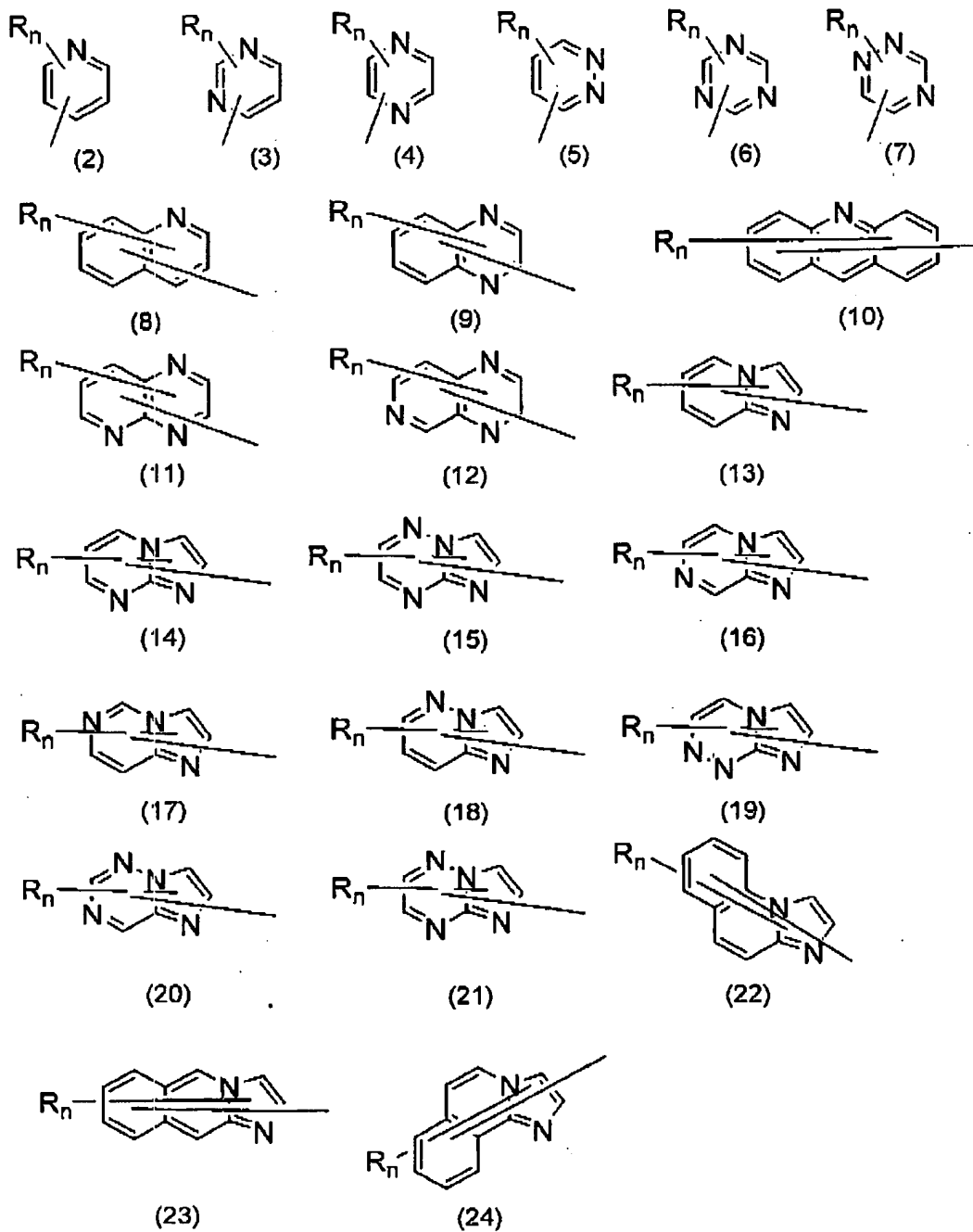
8. (Previously Presented) The organic electroluminescence device emitting white light according to Claim 1, wherein the electron transporting layer comprises a heterocyclic derivative having a nitrogen atom represented by following general formula (1):



wherein HAr represents a substituted or unsubstituted heterocyclic group having a nitrogen atom, Ar¹ represents a substituted or unsubstituted divalent aromatic hydrocarbon group having 6 to 40 carbon atoms, Ar² represents a substituted or unsubstituted aryl group having 6 to 40 carbon atoms or a substituted or unsubstituted heteroaryl group having 3 to 40 carbon atoms, and L represents a single bond or a substituted or unsubstituted arylene group.

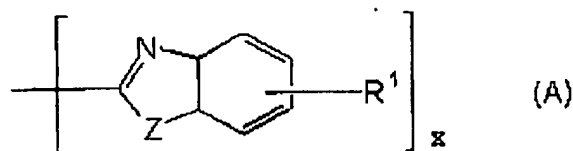
9. (Previously Presented) The organic electroluminescence device emitting white light according to Claim 8, wherein HAr represents a heterocyclic group represented by one of following formulae (2) to (24):

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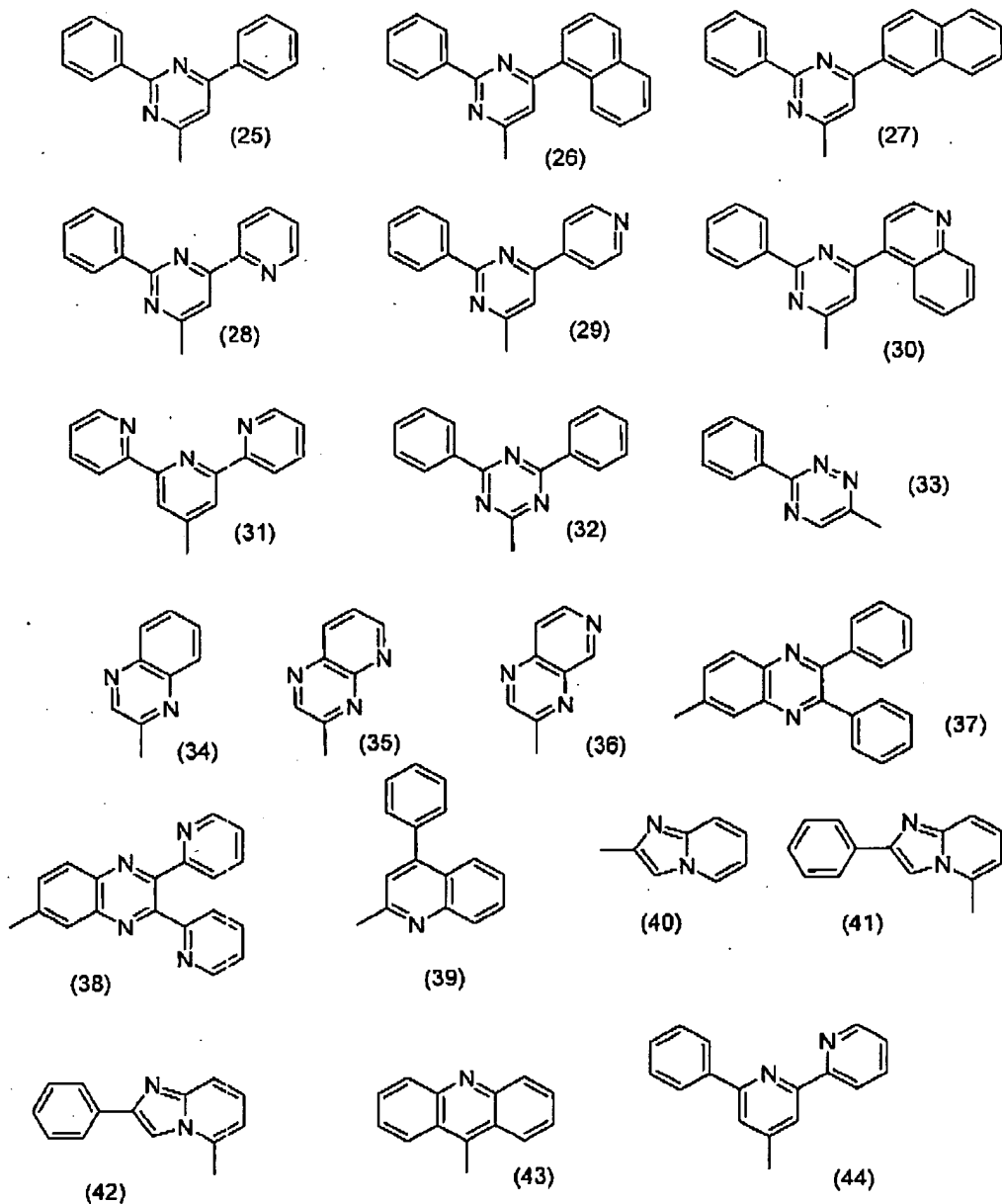
wherein R represents a substituted or unsubstituted aryl group having 6 to 40 carbon atoms, a substituted or unsubstituted heteroaryl group having 3 to 40 carbon atoms, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms or a substituted or unsubstituted alkoxy group having 1 to 20 carbon atoms, n represents an integer of 0 to 5 and, when n represents an integer of 2 or greater, a plural R may represent a same group or different groups, and the plurality of groups represented by R may be bonded to each other to form a cyclic structure; and formula (A):



wherein a plural R¹ each independently represent hydrogen atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms, a substituted or unsubstituted aryl group having 6 to 40 carbon atoms, a substituted or unsubstituted heteroaryl group having 3 to 40 carbon atoms or a group forming a condensed aromatic group, Z represents oxygen atom, sulfur atom or a group represented by NR', R' representing a same atom or group as that represented by R¹, and x represents an integer of 2 to 8; or a substituted or unsubstituted carbazolyl group.

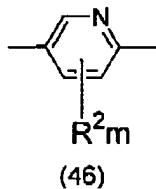
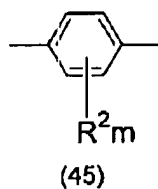
10. (Original) The organic electroluminescence device emitting white light according to Claim 8, wherein HAr represents a group expressed by one of following formulae (25) to (44):

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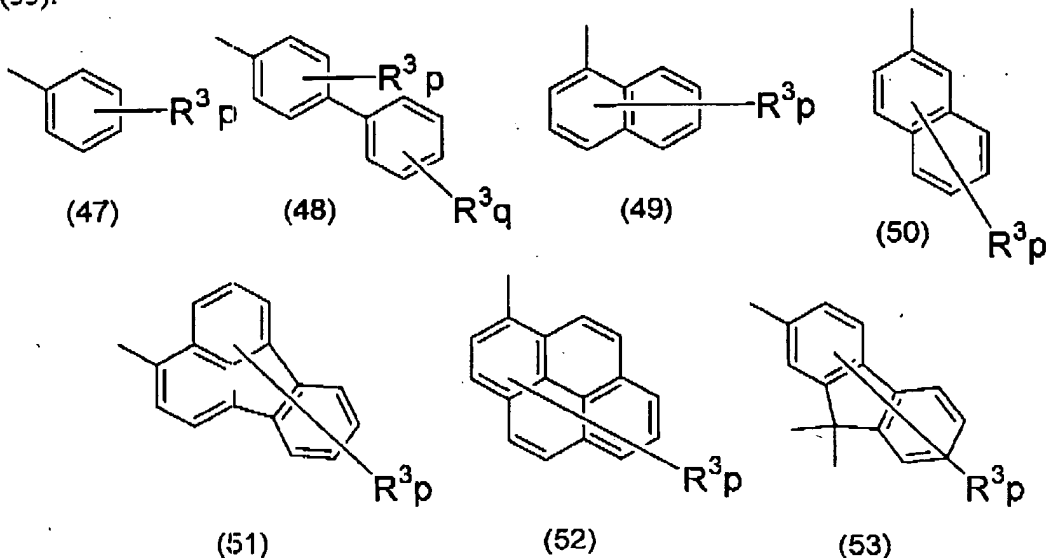
11. (Original) The organic electroluminescence device emitting white light according to Claim 8, wherein L represents a group represented by one of following formulae (45) and (46):

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wherein R^2 represents a substituted or unsubstituted aryl group having 6 to 40 carbon atoms, a substituted or unsubstituted heteroaryl group having 3 to 40 carbon atoms, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms or a substituted or unsubstituted alkoxy group having 1 to 20 carbon atoms, m represents an integer of 0 to 4 and, when m represents an integer of 2 or greater, a plural R^2 may represent a same group or different groups, and a plural group represented by R^2 may be bonded to each other to form a cyclic structure.

12. (Original) The organic electroluminescence device emitting white light according to Claim 8, wherein Ar^2 represents a group represented by one of following formulae (47) to (53):

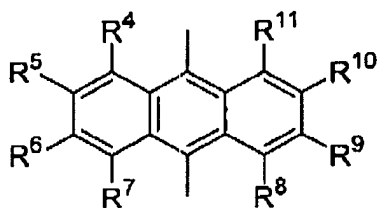


wherein R^3 represents a substituted or unsubstituted aryl group having 6 to 40 carbon atoms, a

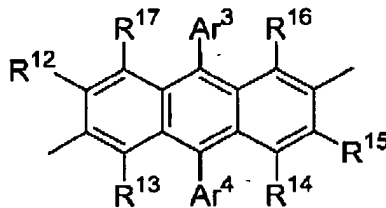
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substituted or unsubstituted heteroaryl group having 3 to 40 carbon atoms, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms or a substituted or unsubstituted alkoxyl group having 1 to 20 carbon atoms, p represents an integer of 0 to 9, q represents an integer of 0 to 5 and, when p or $p+q$ represents an integer of 2 or greater, a plural R^3 may represent a same group or different groups, and a plural group represented by R^3 may be bonded to each other to form a cyclic structure.

13. (Original) The organic electroluminescence device emitting white light according to Claim 8, wherein Ar^1 represents a group represented by one of following formulae (54) and (55):



(54)



(55)

wherein R^4 to R^{17} each independently represent hydrogen atom, a halogen atom, a substituted or unsubstituted aryl group having 6 to 40 carbon atoms, a substituted or unsubstituted aryloxy group having 6 to 40 carbon atoms, a substituted or unsubstituted heteroaryl group having 3 to 40 carbon atoms, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms or a substituted or unsubstituted alkoxyl group having 1 to 20 carbon atoms, and Ar^3 and Ar^4 each represent a substituted or unsubstituted aryl group having 6 to 40 carbon atoms or a substituted or unsubstituted heteroaryl group having 3 to 40 carbon atoms.